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A bolometer cooled by a He-3 refrigerator has been built to detect small anisotropies in the cosmic background radiation. This bolometer can be tested on ground-based instruments and is proposed to be eventually used on a shuttle-borne system.

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Final Technical Report, AFOSR
Sunyaev-Zel'dovich Effect

Equipment Status as of March 31, 1986:

The liquid helium cryostat has been modified for use with dish antenna and Winston cone beam optics, and has been demonstrated to hold liquid helium with a maximum input heat leak of no more than 200 mW. Typical heat input was below 100 mW under normal operating conditions.

Plumbing has been installed on the cryostat to allow controlled pumpdown of liquid helium to near–vacuum condition. The pump and assorted plumbing was tested and demonstrated to work as planned; additional hardware will not be necessary to operate the cryostat at 1.5 K.

A low–noise x1000 preamp has been built and tested. The input consists of a cooled JFET operating within the helium cryostat, approximately one inch from the bolometer. The JFET self–heats to its operating temperature of 77 K.

Two bolometers (obtained from Harvey Moseley at Goddard Space Flight Center) have been installed and tested at 4 K. The Noise Equivalent Power (NEP) of each was determined.

Bolometer #1: NEP = 1×10^{-13} W $Hz^{-1/2}$
Bolometer #2: NEP = 8×10^{-14} W $Hz^{-1/2}$

A lowpass capacitive–mesh microwave filter was built to our specifications at the UCB Microfabrication Facility and installed in the cryostat. Nominal passband: f < 115 GHz. Funding was discontinued as testing of the filter was beginning.

The entire system (bolometer, filter, optics, cryostat, and assorted electronics) have been assembled into a single–channel detector with 0.5 degree beamwidth and a nominal passband of 80–115 GHz. Funding was discontinued before the integrated system could undergo full laboratory testing (cold/ambient targets) and astronomical testing (moon/planets). The system was demonstrably non–microphonic and had noise within a factor of two of the Johnson limit.

At the end of the funding, the equipment was stored in operational condition. The equipment will be kept intact for a reasonable period. The cryostat may eventually be used for another experiment.